

## AIR-FLOW ROUTING IN THE BOTTOM PART OF A VACUUM CLEANER

**[0001]** Priority is claimed to German patent applications DE 102 46 674.2 and DE 102 46 675.0, the subject matters of both of which are hereby incorporated by reference herein. Moreover, the subject matter of all references cited herein are hereby incorporated by reference herein.

**[0002]** The present invention relates generally to vacuum cleaners, and particularly to a vacuum cleaner including a handle and a bottom part with two flows paths guided into a dust chamber via a common inlet opening.

### BACKGROUND

**[0003]** A vacuum cleaner having a bottom-side suction opening and an additional suction opening for a suction hose is known from U.S. Patent No. 6,317,920 B1. The known vacuum cleaner has an approximately square dust chamber that is bounded by dust-chamber walls and has an inlet opening formed in the front wall and rear wall for the air sucked in by the fan unit. The inlet opening in the front wall leads via a first flow path to the bottom-side suction opening whereas the inlet opening in the rear wall is in communication with the additional suction opening via a second separate flow path.

**[0004]** It is considered a disadvantage of this known vacuum cleaner that, due to the two inlet openings into the dust chamber, it is not possible to use conventional and inexpensive dust-collecting devices, in particular dust bags, having a single opening for feeding dirt- and/or dust-laden air. This disadvantage can be eliminated by a vacuum cleaner as disclosed in German Patent DE 1 208 457.

**[0005]** This vacuum cleaner has a Y-shaped elastic suction nozzle where flow paths from a bottom-side suction opening and from an additional and upwardly directed suction opening for connecting a suction hose jointly open into a short tubular member. This short tubular member extends into a dust chamber where it serves to receive a conventional dust-collecting device

having a single inlet opening, in particular dust bags. In the first flow path from the bottom-side suction opening to the short tubular member, the suction nozzle contains a disk spring-like diaphragm upstream of the mouth, the disk spring-like diaphragm allowing manual closure of the air passage to the short tubular member. The user can move this diaphragm into its closed position by compressing the elastic suction nozzle and into its open position by expansion.

**[0006]** If the air passage from the bottom-side suction opening to the short tubular member is closed, the full suction power is available for vacuuming through the suction hose that is connected to the additional suction opening. However, at full suction power, thin textiles such as curtains, tablecloths, etc. can be vacuum cleaned only with difficulty because they are drawn into the suction hose due to the high suction power. When the air passage to the bottom-side suction opening is open, the suction power on the hose side is actually reduced, however, resulting in the disadvantage that heavy particles that are drawn in through the hose, due to their high kinetic energy, flow past the short tubular member opening into the dust-collection device and, via the first flow path through bottom-side suction opening, land on the floor. This danger is particularly high when the vacuum cleaner is turned off while vacuuming through the hose, or in the case of low suction power, for example, when the dust bag is full. In both cases, the heavy particles are moved through the suction hose and the bottom-side suction opening to the floor like on a chute due to their gravitational force.

#### SUMMARY OF THE INVENTION

**[0007]** It is therefore an object of the present invention to provide a vacuum cleaner in which particles that are drawn in through the suction hose are reliably conveyed into the dust chamber or the dust-collecting device inserted therein even at low suction power.

**[0008]** The present invention provides a vacuum cleaner 1 having a handle 5 and a bottom part 4, the handle 5 being swivel-mounted to the bottom part 4 via an articulated joint 9 and the bottom part 4 containing at least one bottom-side suction opening 18; a dust chamber 13 bounded by dust chamber walls 25, 31; a fan unit; and additional suction opening 19 for a suction hose 7. A first flow path 20 through the bottom-side suction opening 18 and a separate parallel flow path

21 through the additional suction opening 19 are guided into the dust chamber 13 via a common inlet opening. The two flow paths 20, 21 are arranged in the bottom part 4 and guided into the inlet opening together and approximately parallel to each other by a flow-guide element 28 located between the two flow paths 20, 21, the inlet opening being provided in one of the dust chamber walls 25, 31.

**[0009]** In an embodiment of the vacuum cleaner according to the present invention, provision is made for the flow-guide element located between the two flow paths to be formed by a dividing wall that divides the short tubular member into a first inlet region and a second inlet region, the first flow path opening into the first inlet region and the second flow path opening into the second inlet region. This design provides a flow-guide element in a simple and inexpensive manner.

**[0010]** A further embodiment of the present invention provides for one of the two flow paths to run parallel to a dust chamber wall at least in one region. Due to this flow path configuration, the dust chamber wall serves both to bound the dust chamber and to guide the air of the parallel flow path.

**[0011]** In an embodiment of the vacuum cleaner according to the present invention, in which the additional suction opening and the suction hose are in fluid communication and the suction opening of the suction hose can be closed by a closing element, provision is made for the suction hose to be in fluid communication with a secondary air device that allows adjustment of the vacuum in the second parallel flow path when the suction opening is closed, and thus, of the suction power at the bottom-side suction opening. This design allows the secondary air device to be placed at an ergonomically convenient location for the user, eliminating the need for it to be provided on the bottom part in the flow path to the bottom-side floor nozzle.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** The present invention is elaborated upon below based on an exemplary embodiment with reference to the drawings, in which:

Figure 1 is a side view of a vacuum cleaner including a handle with a parking fixture for a suction hose as well as a bottom part;

Figure 2 is a perspective view of the lower shell of the bottom part of Fig. 1 with mounted articulated joint;

Figure 3 shows the lower shell of Fig. 2 from a different perspective;

Figure 4 is a perspective view of the lower shell of Fig. 3 without the articulated joint;

Figure 5 is a side view of the parking fixture of the vacuum cleaner of Fig. 1 with the secondary air device in an open position; and

Figure 6 is a schematic sectional view of the parking fixture.

#### DETAILED DESCRIPTION

**[0013]** Vacuum cleaner 1 shown in Fig. 1 has a bottom part 4 that can be rolled on front wheels 2 and rear wheels 3, a handle 5 with a hand grip 6, and a suction hose 7. Handle 5 is swivel-mounted to bottom part 4 via a quiver 8 for holding suction hose 7 and an articulated joint 9 supported at the end face in the region of rear wheels 3.

**[0014]** As shown in Fig. 1, bottom part 4 has a housing including a lower shell 10, an upper shell 11 and two adjacent hinged covers 12.1, 12.2. Inside the housing, a dust chamber 13 containing a dust-collecting device is located below first cover 12.1, and a receiving chamber 15 containing a fan unit is located below second cover 12.2 (see Figs. 2, 3, 4).

**[0015]** Figures 2 through 4 show lower shell 10 in a perspective view. In lower shell 10, receiving chamber 15 for accommodating the fan unit and dust chamber 13 for receiving a dust-collecting device are formed by walls; dust chamber 13 and receiving chamber 15 being immediately adjacent to each other, and the front wall of receiving chamber 15 being formed by a

portion of dust chamber rear wall 17. Moreover, lower shell 10 has formed therein a bottom-side suction opening 18, an additional suction opening 19 to which can be connected suction hose 7, and two flow paths 20, 21. First flow path 20 and second flow path 21 connect dust chamber 13 to bottom-side suction opening 18 and to additional suction opening 19, respectively.

**[0016]** Bottom-side suction opening 18 is provided centrally on lower shell 10, ahead of front wheels 2 in working direction A. Bottom-side suction opening 18 extends substantially vertically into lower shell 10 and opens into first flow path 20.

**[0017]** Additional suction opening 19 is formed by a bearing for articulated joint 9 (see Fig. 4), articulated joint 9 having a through-channel for suction hose 7 through which the fluid communication can be established between additional suction opening 19 and suction hose 7. Alternatively, additional suction opening 19 can be formed by a separate housing opening to which suction hose 7 can be connected in a manner known per se.

**[0018]** Rectangular-shaped dust chamber 13 is located at a short distance behind front wheels 2 in working direction A of vacuum cleaner 1. In the left region of dust chamber rear wall 17 as viewed in working direction A, provision is made for an outlet opening 24 to receiving chamber 15 of the fan unit; the fan unit bearing against the outlet opening with the suction side when the vacuum cleaner is in the assembled state.

**[0019]** On right dust chamber wall 25 as viewed in working direction A, there is formed a short tubular member 26 as an inlet opening to dust chamber 13 which extends into dust chamber 13 and through which flow paths 20, 21, which run towards each other in the direction of flow (see Fig. 3), are guided into dust chamber 13 together and approximately parallel to each other. In order to insert both a dust bag and a firm dust container as a dust-collecting device into dust chamber 13, short tubular member 26 extends into dust chamber 13. In general, the short tubular member has a rigid design, but can also be made from an elastic material. Alternatively to the aforementioned short tubular member 26, it is also possible to use only a hole in dust chamber wall 25 as an inlet opening to dust chamber 13 through which hole the two flow paths 20, 21 are

guided into dust chamber 13 approximately together and parallel to each other. The dust-collecting device to be inserted then seals against the inlet opening.

**[0020]** In order for even heavy particles to maintain their predetermined flow path 20, 21 during vacuuming and not to flow past the inlet opening into the other flow path because of their high kinetic energy, the two flow paths 20, 21 are separated from each other by a flow-guide element 28. In the exemplary embodiment, flow-guide element 28 is formed by a straight dividing wall. Alternatively, flow-guide element 28 can also be formed by a contour that is more convenient in terms of fluid mechanics, for example, a radius.

**[0021]** As shown in Figures 2, 4, the dividing wall extends up and into short tubular member 26, dividing it into a first inlet region 32a and a second inlet region 32b. Due to the attachment of the dividing wall in short tubular member 26, the dividing wall is secured in a stable manner.

**[0022]** The alignment of a dust bag opening with respect to the inlet opening is normally accomplished in that a holding plate arranged around the dust bag opening is moved along the inlet opening toward dust chamber bottom 29 until the dust bag opening is level with the inlet opening. To prevent jamming of the holding plate with short tubular member 26 during the alignment described above, the lower portion of the straight dividing wall is designed as a guide slope that extends at an angle from the center of the short tubular member toward the dust chamber bottom, the lower portion of the guide slope slightly projecting beyond short tubular member 26 into dust chamber 13 at the height of the bottom 26.1 of the short tubular member.

**[0023]** First flow path 20 runs along the outer face of dust chamber front wall 31 and along dust chamber wall 25, which is to the right as viewed in working direction A, so that these dust chamber walls 31, 25 serve both as boundary walls for dust chamber 13 and for guiding first flow path 20. Analogously, second flow path 21 uses the rear portion of right dust chamber wall 25 as viewed in working direction A.

**[0024]** During the operation of the vacuum cleaner 1, the full suction power is only available at

floor nozzle 18 when the handle-side suction opening of suction hose 7 is closed, since suction hose 7 and floor nozzle 18 are simultaneously in fluid communication with the fan unit and dust chamber 13 via separate flow paths 20, 21.

[0025] Therefore, a closing element that is designed as a parking fixture 33 is secured on the telescoping handle 6 near hand grip 6a for closing suction hose 7, it being possible for the suction-side suction hose end 34 or the accessory 35 connected thereto to be received or parked in the closing element in a positive-locking, substantially airtight and detachable manner.

[0026] As shown in Fig. 6, parking fixture 33 includes a receiving region 36 which is positive locking on the peripheral side with respect to accessory 35 and which has a receiving opening 37. Receiving opening 37 points in a direction facing away from hand grip 6a. When the accessory 35 connected to suction hose 7 is inserted in receiving opening 37, suction-side hose end 34 extends in an approximately straight line as shown in Fig. 1.

[0027] As shown in Figure 6, receiving region 36 is spring-biased and designed in such a manner that it can be moved in the direction of hand grip 6a against the force of spring 38. When receiving region 36 is pushed up into its upper end position in the direction of hand grip 6a against the force of spring 38, the positive connection to accessory 35 is released. When the user releases the pushed-up receiving region 36, the receiving region is returned down to its original position by the force of spring 38, thus securing the accessory 35 parked as shown in Figs. 1, 5 and 6.

[0028] A secondary air device in the form of a secondary air slide 39 is arranged at receiving region 36. As shown in Fig. 5, secondary air slide 39 is guided by its grooves 40 with their stop edges 41a, 41b, which are provided on the side walls, and by ribs 42 that are formed at receiving region 36 and engage with grooves 40.

[0029] This design allows secondary air slide 39 to be gradually moved down to its lower end position in the direction of the handle end on the side of the articulated joint, in which position

the ribs 42 abut against upper stop edges 41a. In doing so, a correspondingly large secondary air opening 43 is cleared. When secondary air opening 43 is cleared while vacuum cleaner 1 is in operation and suction hose 7 is connected and parked via accessory 35, the fan unit sucks in air L through floor nozzle 18 and also through secondary air opening 43, allowing the suction power at bottom-side suction opening 18 to be gradually adjusted by changing the size of secondary air opening 43 with secondary air slide 39. This eliminates the need for a secondary air adjusting device at the floor nozzle.

**[0030]** The above-described arrangement of the secondary air device is not limited to the vacuum cleaner according to the present invention with the special design of the two flow paths. Rather, the secondary air device can be used on all vacuum cleaners which have a bottom-side suction opening and a suction hose, and in which the flow paths of the suction hose and the bottom-side suction opening are in parallel and in fluid communication.